REMARKS

Claims 1-11 are pending in the application. Independent claims 1, 4, and 9 have been amended to correct inadvertent errors. For example, independent claim 1 has been amended to recite: "the pixels are identified and provided with color representing the shadow if the pixels are associated with a front-facing shadow polygon in front of one of the normal polygons, and a back-facing shadow polygon in back of the one of the normal polygons." The amendments are fully supported by the application as originally filed.

Claims 1, 2, 4, 5, and 9-11 were rejected under 35 USC 102(b) as being anticipated by U.S. Patent 6,384,822 to Bilodeau et al. ("Bilodeau"). Claims 1, 3, 4, 6, and 9-11 were rejected under 35 USC 103(a) as being unpatentable over U.S. Patent 6,744,430 to Shimizu in view of Bilodeau. The remaining claims were rejected based on at least the Bilodeau reference. These rejections are respectfully traversed.

In the "Response to Arguments" section on page 2, paragraph #2 of the Office Action of 09/28/2011, it was stated: "The key is the processing sequence of the back-facing shadow polygons and the front-facing shadow polygons. Applicant did not claim a specific processing sequence."

However, it is noted that the Applicant's claimed invention can be implemented regardless of the processing sequence of the back- and front-facing shadow polygons.

Attached hereto in an *Appendix* to this response is a document containing *FIGS. 1-12*. As shown in *Fig. 1 of the Appendix*, it is assumed that a plain polygon (normal polygon) 1 is to be shadowed with use of a cylindrical shadow volume 2 (group of polygons for shadowing use). *Fig. 2 of the Appendix* shows (in black) a region A where a front-facing shadow polygon passes the depth test (Z test). *Fig. 3 of the Appendix* shows (in black) a region where the front-facing shadow polygon fails the Z test. *Fig. 4 of the Appendix* shows (in black) a region B where back-facing shadow polygon passes the Z test. *Fig. 5 of the Appendix* shows (in black) a region where the back-facing shadow polygon fails the Z test.

According to the "OpenGL" shadowing method, as described in paragraphs 0013-0015 of the subject application, first, front-facing shadow polygons are subjected to the Z test (depth test) and a front-facing shadow polygon that passes the Z test (depth value of the shadow polygon is smaller than Z value in the Z-buffer memory) is written with the numeral "1" (shadowed in black), and then back-facing shadow polygons are subjected to the Z test and a back-facing shadow polygon that passes the Z test is added with the numeral "-1" (turned into white). *Fig. 6 of the Appendix* illustrates this process and, as shown in the upper part, the front-facing shadow polygon A having passed the Z test is shadowed in black and, as shown in the middle part, the back-facing shadow polygon B having passed the Z test indicated in black turns into white and as a result of adding the numeral "-1", as shown in the lower part, black shadowing A-B is obtained on the plain polygon (normal polygon) 1.

According to a shadowing method described in Bilodeau, e.g., as recited in claim 1 of Bilodeau (see column 5, line 61 to column 6, line 5), back-facing shadow polygons are subjected to the Z test, and a back-facing shadow polygon that fails the Z test (i.e., passes the inverted Z test) is written with "1" (incrementing buffer entry), and then front-facing shadow polygons are subjected to the Z test and a front-facing shadow polygon that fails the Z test (i.e., passes the inverted Z test) is added with the numeral "-1" (decrementing buffer entry). *Fig. 7 of the Appendix* illustrates this process and, as shown in the upper part, the back-facing shadow polygon having failed the Z test is written with "1" (shadowed in black) and, as shown in the middle part, a front-facing shadow polygon having failed the Z test indicated in black now turns white by adding the numeral "-1" and, as shown in the lower part, black shadowing is obtained on the plain polygon (normal polygon).

In contrast to these, the shadowing method of independent claim 1, fourth paragraph recites: "obtaining the depth value of each pixel of the back-facing shadow polygons, comparing the depth value with a corresponding Z value obtained from the Z-buffer memory, and if the depth value of each pixel of the back-facing shadow polygons is equal to or greater than the corresponding Z value, then the pixel is processed as the back-facing shadow polygon."

According to the above claim limitation, the back-facing shadow polygons are subjected to the Z test, and a back-facing shadow polygon that fails the Z test (Z test-failed back-facing shadow polygon, i.e., a back-facing shadow polygon in back of one of the normal polygons) is written with the numeral "1" and colored black.

As recited in independent claim 1, fifth paragraph: "obtaining the depth value of each pixel of the front-facing shadow polygons, comparing the depth value with a corresponding Z value obtained from the Z-buffer memory, and if the depth value is smaller than the corresponding Z value, then the pixel is processed as the front-facing shadow polygon."

According to the above claim limitation, the front-facing shadow polygons are subjected to the Z test, and a front-facing shadow polygon that passes the Z test (Z test-passed front-facing shadow polygon, i.e., a front-facing shadow polygon in front of one of the normal polygons) is written with the numeral "1" and colored black.

As recited in independent claim 1, sixth (last) paragraph: "the pixels are identified and provided with color representing the shadow if the pixels are associated with a front-facing shadow polygon in front of one of the normal polygons, and a back-facing shadow polygon in back of the one of the normal polygons."

According to the above claim limitation, a pixel being located between the front-facing shadow polygon and the back-facing shadow polygon is written with the numeral "1" indicating being within the shadow and colored black, thus an intersection of the Z test-failed back-facing-shadow polygon and the Z test-passed region of the front-facing shadow polygon is calculated and the intersection is colored black.

Fig. 8 of the Appendix illustrates the above claimed steps and, as shown in the upper part, a region of the back-facing shadow polygon having failed the Z test (i.e., a back-facing shadow polygon in back of one of the normal polygons) is shadowed in black and, as shown in the middle part, a front-facing shadow polygon A having passed the Z test (i.e., a front-facing shadow polygon in front of the normal polygon) indicated in black and, as shown in the lower

part, an intersection of the back-facing shadow polygon in back of the plain polygon (normal polygon) 1 and the front-facing shadow polygon A in front of the plain polygon (normal polygon) 1 is calculated and as a result black shadowing is obtained on the plain polygon (normal polygon) 1.

The shadowing methods of "OpenGL" and Bilodeau, which differ from the claimed shadowing method and apparatus, can cause a serious problem when calculation values of coordinate conversion for polygons have errors. When a shadowing method has such calculation errors, as shown in *Fig. 9 of the Appendix*, the back-facing shadow polygons shift a little leftward relative to the front-facing shadow polygons. According to the method of "OpenGL," as shown in *Fig. 10 of the Appendix*, a front-facing shadow polygon A above the plain polygon (normal polygon) 1 (i.e., in front of the plain polygon 1) is written with "1" and a back-facing polygon B shifting a little leftward above the plain polygon 1 is written with "-1," and thus the right edge of the front-facing shadow polygon A written with "1" is not cancelled by "-1" of the back-facing shadow polygon B. As a result, a black dust strip L remains at a right upper edge.

According to the method of Bilodeau, as shown in *Fig. 11 of the Appendix*, the back-facing shadow polygon below, or in back of, the plain polygon (normal polygon) 1 is written with "1" and a front-facing polygon shifting a little rightward below, or in back of, the plain polygon 1 indicated in black is written with "-1," and as a result the left edge of the back-facing shadow polygon written with "1" is not cancelled by "-1" of the front-facing shadow polygon. Therefore, a black dust strip L remains at a left lower edge.

In contrast to the above deficiencies, according to the method of independent claim 1, as shown in *Fig. 12 of the Appendix*, the back-facing shadow polygon below, or in back of, the plain polygon (normal polygon) 1 is written with "1" and colored black, a region of the front-facing shadow polygon A shifting a little rightward above the plain polygon (normal polygon) 1 is written with "1" and colored black, and an intersection of the black-colored back-facing shadow polygon and the black-colored front-facing shadow polygon A is calculated. As a result, black shadowing without any black dust strip L is obtained. This effect is due to the distinguishing method of independent claim 1 (and independent claims 4 and 9) that a shadowing

region is obtained by calculating the intersection of the region of the back-facing shadow polygon having failed the Z test and the region A of the front-facing shadow polygon having passed the Z test. In contrast, the methods of "OpenGL" and Bilodeau obtain a shadowing region by modifying a region of front- or back-facing shadow polygon written with "1" with an overlapping region of back- or front-facing polygon written with "-1".

As described above, independent claim 1 recites that an intersection of the Z test-failed region of the back-facing shadow polygon and the Z test-passed region of the front-facing shadow polygon is calculated and results in black shadowing being obtained (see independent claim 1, fourth to sixth paragraphs). Therefore, it is not important whether the Z test of the back-facing shadow polygon or the front-facing polygon is first processed, but it is important only to calculate the intersection of the regions of both the back-facing and front-facing shadow polygons. The calculation result is the same even if the Z test of the front-facing shadow polygon is processed first.

As discussed above, the shadowing method of "OpenGL" and Bilodeau do not teach or suggest the subject matter of independent claim 1 (and independent claims 4 and 9), in particular that "the pixels are identified and provided with color representing the shadow if the pixels are associated with a front-facing shadow polygon in front of one of the normal polygons, and a back-facing shadow polygons in back of the one of the normal polygons."

For at least the reasons discussed above, the Bilodeau reference, whether taken alone or in combination with Shimizu, does not teach or suggest a graphic processing apparatus or method including at least the above limitations, as recited in independent claims 1, 4, and 9. Therefore, independent claims 1, 4, and 9 and their respective dependent claims are patentable over Bilodeau (or Shimizu in view of Bilodeau).

It is believed the application is in condition for immediate allowance, which action is earnestly solicited.

Respectfully submitted,

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